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Quarterly Update

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Summary of SEI Accomplishments: 1Q90

The **Software Capability Evaluation (SCE) Project** presented an introductory course on using the SCE method in selecting contractors to the Space and Naval Warfare System Command (SPAWAR), who will sponsor the pilot use of the SCE method in its acquisitions.

The **Capability Maturity Model Workshop** was held in March at the SEI. Sixty-two people from 40 government and industry organizations attended.

The **Software Metrics Definition Working Group** and the **Software Metrics Acquisition Working Group** met separately in January. Both groups are developing documents that specify measures of products, processes, and project characteristics that can be widely and consistently used.

The **Software Engineering Process Definition Project** completed initial planning. This project supports process improvement through the maturation of the methods and technology associated with software engineering process definition.

Members of the **Software Process Modeling Project** delivered a model of the F-16 software change process to Ogden Air Logistics Center.

The **Domain Analysis Project** entered a feasibility study phase. Project members are developing and testing methods for performing domain analysis to support software reuse.

Members of the Real-Time Embedded Systems Testbed Project completed the first version of the **Hartstone benchmark**, a set of timing requirements for testing a system's ability to handle real-time applications.

The SEI established working relationships with four organizations to build prototyping and modeling tools for real-time systems using the **Durra software**, which describes distributed applications running on heterogeneous machines.

Two new courses were offered by Carnegie Mellon as part of its new **Master of Software Engineering** program, a joint effort between the SEI and the CMU School of Computer Science.

The seventh **Educator Development Workshop** was held in January. The 85 participants addressed educational issues and received SEI curriculum modules and other materials.

The Academic Series of the **Video Dissemination Project** began its sixth semester of production by videotaping two courses: Software Creation and Maintenance, and Software Verification and Validation.

The **Distributed Ada Real-Time Kernel (DARK) Project** concluded development and established baseline version 3.0 of the Kernel software and documentation for MC68020 and VAX/VMS.

Sixteen new **Industry affiliates**, one new **academic affiliate**, and thirteen new **resident affiliates** joined the SEI this quarter.

The **Computer Emergency Response Team Coordination Center (CERT/CC)** established an online repository of computer security information.

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This section provides
a summary of
accomplishments from
January-March 1990

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Software Engineering Process

The Software Engineering Process Program focuses on improving the process of software development. Projects within the program are assessing the actual practice of software engineering in the defense community, training organizations to gain management control over their software development processes, supporting the use of quantitative methods and measures as a basis for process improvement, and developing improved methods for software process management.

The Process Program has an advisory board that reviews its work and provides informal comments and suggestions to guide its activities. The members of this board are:

Dr. Stephen Fienberg / Carnegie Mellon University
Dr. Robert Balzer / Information Sciences Institute
Dr. Lee Osterweil / University of California, Irvine
Dr. William Curtis / MCC
Mr. Victor Vyssotsky / Digital Equipment Corp.
Mr. Albert Roberts / Defense Systems Management College

Because of their broad background and association with software work in DoD, industry, and academia, the board members provide informal, stimulating discussions of the program's activities and plans. The board typically meets with the Process Program two or three times a year. The fourth such meeting was held on March 8-9; participants reviewed aspects of all Process projects.

The Software Capability Evaluation (SCE) Project helps DoD acquisition organizations to evaluate the capability of contractors to competently develop and maintain software. The project is improving and transitioning an evaluation method for use in software-intensive acquisitions.

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**Software Capability
Evaluation**

In January 1990, project members conducted a panel at the first Armed Forces Communications and Electronics Association Military/Government Computing Conference and Exposition. The panel, titled "Contractor Software Capabilities Assessment and Evaluation Panel," featured five speakers who discussed their experiences with the SEI software capability assessment method. In addition to the Process Program director and the SCE project leader, representatives from IBM, Raytheon, and Naval Air Development Center participated. The conference was attended by 200 participants from industry and government.

The project presented an introductory course on using the SCE method in selecting contractors to the directors and program managers in Space and Naval Warfare Systems Command (SPAWAR) in Crystal City, Virginia. As a result, SPAWAR will sponsor the pilot use of the SCE method in its acquisitions. ►

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Project members conducted a workshop on the capability maturity model in March at the SEI. The objectives of the workshop were to promote a dialogue on the project's revision effort and plans, and to collect recommendations on the software engineering and management practices covered in the model. Sixty-two people from 40 government and industry organizations attended. In preparation for this workshop, registrants received a paper elaborating the precepts underpinning the maturity questionnaire and model, a set of tables itemizing the practices needed to achieve the software process capability stated in the model, and a report summarizing the unresolved change requests and the user comments associated with each change request.

The Questionnaire Advisory Board (QAB) met for the first time on the day preceding the workshop. Composed of seven government and industry software professionals, this board will independently review and recommend changes to SCE products prior to their release.

The project drafted a product offering, which is a one-page description of the SCE method, its use, and training in it. A timeline for introducing the method into an organization is also included.

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**Software Process
Assessment**

The Software Process Assessment Project assists software organizations in launching effective process improvement programs, characterizes and reports on the software engineering capabilities of defense contractors, and defines priority needs for software process improvement in the defense community.

Project members acted as observers for self-assessments conducted by six organizations: Software Productivity Consortium in Herndon, Virginia; Northrop in Los Angeles, California; Computer Sciences Corporation in Gaithersburg, Maryland; AIRMICS in Tyson's Corner, Virginia; Aluminum Company of America (ALCOA) in Warriek, Indiana; and Tinker Air Force Base in Oklahoma City, Oklahoma. The project frequently provides one or two observers experienced in assessments to attend an organization's initial self-assessment.

Project members and Technology Transition staff conducted the fifth self-assessment training session at the SEI in February. Thirty-two registrants from five affiliate organizations attended. The training prepares software professionals to assess software development processes within their organizations.

Two project members conducted a special self-assessment training session with ALCOA. The purpose of this special session was to understand the process implications of training secondary or site assessment team members. Project members also examined the assessment of small projects.

Two of the four SEI-assisted assessments planned for fiscal year 1990 were completed during this quarter. A final assessment report and a briefing on action recommendations were delivered to Medtronic in Minneapolis in January. The on-site phase was completed for Hughes Aircraft Company/Ground Systems Group in Fullerton, California. (During the on-site phase, the assessment team conducts extensive discussions with project managers and software practitioners, and briefs the senior executives on the team's view of the organization's most pressing software process issues.) A final assessment report and a briefing on action recommendations were delivered to Hughes Aircraft Company/Ground Systems Group in March. ►



Assessment team training was completed for TRW (Systems Integration Division / West Coast) in Redondo Beach, California. Jet Propulsion Laboratories (JPL) submitted a copy of their action plan for review.

Project members were invited to give presentations on process management at the following organizations: GE Productivity Forum in Pittsburgh, Storagetek in Denver, and the Eight Annual National Conference on Ada Technology in Atlanta.

The Software Process Development Project is advocating the use of measurement in the practice of software development and management. Toward that end, it coordinates a steering committee, two working groups, and a best-practices activity, all devoted to encouraging organizations to use quantitative methods to improve their software process.

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**Software Process
Development**

The Software Metrics Definition Working Group and the Software Metrics Acquisition Working Group met separately for three days each in January. Both working groups are developing documents that specify measures of products, processes, and project characteristics that can be widely and consistently used. Both groups have scheduled additional meetings throughout the year and plan to complete a preliminary draft of their documents by January 1991.

The Measurement Steering Committee met for two days in March. It reviewed the status, direction, and progress of the measurement working groups and projects. The committee endorsed their direction and pace.

A correspondence group was formed; it will be the source for future openings in the working groups and the Measurement Steering Committee. More than 100 persons outside the SEI are involved as volunteers in the measurement effort.

To encourage organizations to adopt measurement, project members are collecting best practices and motivations, which will be published in an SEI technical report. To further the collection, project members visited IBM Systems Integration Division in Bethesda, Maryland; Goddard Space Flight Center in Greenbelt, Maryland; McDonnell Douglas Helicopter Co. in Mesa, Arizona; and TRW in Carson, California. Additional visits are planned.

Project members made presentations to the AFCEA (Armed Forces Communications and Electronics Association) Computer Conference in Washington, D.C., the Annual NASA Software Management and Assurance Conference in San Diego, and the Strategic Defense Initiative Metrics Tools Fair in Colorado Springs.

The project hosted representatives from the European ESPRIT METKIT (Metrics Educational Toolkit) project for two days. These representatives joined the correspondence group.

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**Software Engineering
Process Definition**

The Software Engineering Process Definition Project supports process improvement through the maturation of the methods and technology associated with software engineering process definition. The project is developing the capabilities required to support the definition and evolution of software processes within an organization. This project began as a task within the Software Process Development Project.

This project was fully staffed this quarter. Project members met with Standard Systems Center (SSC) personnel at Gunter Air Force Base, and reached agreement on the project's objectives and approach. More detailed planning is currently underway.

Candidates for the Process Definition Steering Committee (PDSC) were selected, and the first meeting was planned. An initial letter was sent to each candidate to request their participation in the PDSC. The Committee will review and provide guidance to the project. The steering committee will be composed of leading software process researchers and practitioners from government, industry, and academia.

Project members began collecting a process definition library. It will include recently published material on process, process modeling, process definitions, process representations, process tailoring, and related areas.

Software Engineering Methods

The primary objective of the Methods Program is to improve the practice of software engineering by improving individual and team productivity through the identification and transition to practice of emerging software technology. Promoting the appropriate use of this technology supports the SEI effort to transform software development from an ad-hoc, labor-intensive activity to a technology-supported engineering discipline.

The Software Development Environments Project is studying the problem of tool configuration management and is tracking the state of environment architectures, with a focus on configuration management (CM) functionality.

To address the problem of managing tool configuration, the project analyzed parameterization and configuration mechanisms in commercial systems and investigated the feasibility of a prototype tool that supports the configuration management of tools in a distributed workstation environment. This quarter, project members analyzed a tool version management technique in a commercial system, and completed an initial data model for the tool configuration modeling prototype.

As part of an effort to assess advances in CM support and new CM concepts, the project has recognized three major usage models in recent commercial CM systems. This quarter the project leader presented this information as part of an all-day tutorial titled "Software Configuration Management: Advances in Software Development Environments" at the 12th International Conference on Software Engineering (ICSE). Project members also completed experiments and a draft report on the benefits and limitations of one of the three usage models as realized in the Sun Network Software Environment (NSE).

The project leader, who is chairing the 3rd International Software Configuration Management Workshop to be held in June 1991 in Norway, issued a call for participation.

To develop a fundamental understanding of structures for the software architecture level of design, this project is describing basic design elements used in the description, analysis, and development of software systems.

Project members attended and presented at several conferences, including the Human-Computer Interaction Consortium and an architecture workshop at Bell Labs.

In January, a project member presented a scheme for describing and classifying architectural choices in user interface software at the quarterly meeting of the IEEE Standards Committee P1201 in New Orleans. This committee is working on standards for graphical user interface software. ►

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Software Development Environments

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Software Architecture Design Principles



The Association for Computing Machinery (ACM) published extensive excerpts from a workshop run by the project leader. The excerpts appeared in *Communications of the ACM*.

An interview with the project leader on engineering history and its lessons for software was published in the March 1990 issue of *IEEE Software*.

The project leader continued to be involved in public service activities, including attending the January meeting of the Computer Science and Technology Board.

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Software Process Modeling

The Software Process Modeling Project is investigating techniques for modeling the software development and maintenance process.

In February, project members delivered the F-16 as-implemented PDSS process model to Ogden Air Logistics Center, and delivered a draft document providing an overview of this model.

As part of the remaining Ogden effort, project members are developing a model of the post-deployment software support process detailed in the draft of MIL-HDBK-347, entitled "Mission-Critical Computer Resources Software Support". Progress on this model was also reviewed at the Ogden meeting in February. Plans for continuing interactions during the remainder of the project were also discussed.

In January, a special session of the 23rd Annual Hawaii International Conference on System Sciences, entitled "Software Engineering Practices: Models and Analysis," was organized and chaired by a project member. The introduction to the session, and the set of scholarly papers, appear in the conference proceedings.

Project members gave a briefing on software process modeling work completed for NAVAIR. The presentation was for the NAVAIR TECR (Tactical Embedded Computer Resources) Executive Advisory Committee, consisting of the chief 1-2 software executive(s) from each of 5 Navy labs supporting NAVAIR weapon systems (for example, Naval Air Development Center [NADC], Naval Weapons Center [NWC], Pacific Missile Test Center [PMTTC], etc.).

A technical meeting was held with the Office of Naval Technology, during which a briefing was given on software process modeling.

The project hosted a technical interchange meeting with personnel from NADC. The NADC group is embarking on a process analysis and improvement effort for certain staff functions at NAVAIR in Washington.

The SEI was represented by a project member at the bimonthly meeting of the Joint Logistics Commanders (JLC) post deployment software support (PDSS) Subgroup. This is a group chartered by the JLC to address the special needs and concerns of software support.

The Domain Analysis Project is developing and testing methods for performing domain analysis to support software reuse. The primary objective of the project is to define a process and set of products to support the systematic discovery and exploitation of commonality across related software systems.

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Domain Analysis

The project established three phases for domain analysis: scoping, which defines a domain for analysis; domain modeling, which provides a description of the problems within the domain; and architectural modeling, which creates the software architecture(s) that implements a solution to the problems in the domain.

During this quarter, the project entered a feasibility study phase. Project members are defining methods and applying them to a small test domain.

Project members made several presentations at external events, including: "Designing for Reuse: Is Ada Class-Conscious?" at the Realities of Reuse Workshop sponsored by Syracuse University; "Software Reuse Technology," a tutorial at the Eighth Annual National Conference on Ada Technology; and a presentation at the First International Workshop on Advanced Computing in Seoul, Korea.

Software Systems

The goal of the Systems Program is to improve the development of real-time distributed systems by integrating software engineering with systems engineering and reducing the risk of new technology.

The Real-Time Embedded Systems Testbed (REST) Project is collecting, classifying, generating, and disseminating information about software development for real-time embedded systems.

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**Real-Time Embedded
Systems Testbed**

Project members completed the first version of the Hartstone benchmark, a set of timing requirements for testing a system's ability to handle hard real-time applications. The accompanying *Hartstone User's Guide, Version 1.0* (CMU/SEI-90-UG-1) describes the structure and behavior of an Ada implementation of one category of Hartstone requirements, the periodic harmonic (PH) test series. The Ada implementation of the PH test series is aimed primarily at real-time embedded processors, where the only executing code is the benchmark and the Ada runtime system. The objective of the PH series is to provide a set of tasks that are periodic and harmonic, these being common in real-time applications. Plans have been developed for distributing the Hartstone program and receiving feedback from users.

SEI testing of the IBM Real-Time Communication Network (RTCN) has uncovered low-level timing anomalies internal to the RTCN. The test programs were delivered to IBM in Manassas, where they are currently investigating the problem. The SEI and IBM are both working on developing suitable workarounds to this problem.

Several distributed processing activities are currently underway. First, project members are writing a concept paper on real-time distributed system issues with an emphasis on schedulability. Second, the project is considering several real-time distributed demonstration systems for incorporation into its testbed. These systems include an enhanced version of the avionics software system currently in use by the SEI Software for Heterogeneous Machines Project, as well as the real-time scenarios described in the paper "Real-Time System Scenarios," delivered by Pat Watson (IBM, Manassas) to the Office of Naval Research. Third, project members are defining real-time benchmark programs for testing the throughput, predictability, and schedulability of distributed networks.

The project successfully tested a new connection strategy for its testbed—a strategy that allows greater connectivity between workstations, hosts, and target machines.

The Real-Time Scheduling in Ada Project is demonstrating how to design and implement real-time systems using analytic scheduling algorithms.

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**Real-Time Scheduling
in Ada**

Project members made a presentation to the PAVE PACE visitors from Wright-Patterson Air Force Base on the prospects for using rate monotonic theory in distributed applications. The project is attempting to establish a formal relationship with the PAVE PACE Program as a vehicle for extending and transitioning real-time scheduling in Ada technology to distributed systems. ►



The project completed an analysis of problems that might be encountered in standardizing commercial backplanes, local area networks, and operating systems for use on real-time Navy systems. An important recommendation was to suggest that work on operating system standardization pay more attention to performance issues, namely, by specifying performance standards to help ensure that conforming implementations provide predictable and acceptable worst-case performance when used for real-time applications.

NASA Space Station is considering making a commitment to using rate monotonic scheduling theory as the default approach for real-time work. Project members addressed the concerns of IBM, McDonnell Douglas, and NASA representatives about the risks of adopting rate monotonic theory.

Work began on transitioning real-time scheduling in Ada technology to the Navy's BSY-2 Program. In March, the project held a two-day workshop with BSY-2 engineers to explore the applicability of rate monotonic theory to BSY-2. This workshop was the first of a series of planned technical interactions.

A draft of the FutureBus+ handbook, which discusses how to make effective use of the FutureBus+ design, was completed and sent to review.

An article on rate monotonic scheduling and its application to Ada was accepted for publication by *Computer Magazine*. The article will appear in the April 1990 issue.

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User Interface

The User Interface Project is developing Serpent, a user interface management system. Serpent separates the concerns of the user interface from those of the application, which allows integration of input/output technologies without modifying the functional portion of the application.

Four Open Software Foundation Motif widgets—the bulletin board, text, label, and push button—were integrated into Serpent. Development also continued on an interactive editor that will allow the visual specification of user interfaces.

Three project members presented a Serpent tutorial at the Third X Window Technical Conference in Boston. There were more than 100 attendees, many of whom are interested in Serpent. The project leader chaired a birds-of-a-feather session on UIMSs attended by more than 70 people.

A Serpent presentation was made by a former resident affiliate to the USENIX Winter Conference. Project members also gave Serpent presentations at ESL, TRW, Computer Science Corporation, and a NASA workshop on the workstation of the future.

There are currently more than 75 users of Serpent divided among research, academic, and industrial sites.

The Software for Heterogeneous Machines Project is developing tools and a methodology for building distributed, large-grained, concurrent applications running on heterogeneous machine networks. The project has developed Durra, a language for describing distributed applications as a set of *task descriptions* and *type declarations* that prescribe a way to manage the resources of the network.

Project members completed the initial port of the Durra runtime to the Nectar architecture developed by the CMU School of Computer Science and have successfully run a simple Durra application on one Nectar host. Work will continue to distribute the application over multiple Nectar hosts and to allow for dynamic reconfiguration.

Project members redesigned the C version of the Durra interface in the process of making it conform to the Ada version. Durra applications tasks can be written in C and Ada.

Project members submitted an article on developing fault-tolerant distributed systems to the 1989 *SEI Technical Review*. The article describes the fault-tolerant features of Durra.

The project leader presented a paper on the Durra language at the 3rd IEEE Computer Society International Conference on Computer Languages in New Orleans. This biennial conference is organized by the IEEE Computer Society Technical Committee on Computer Languages. The project leader was appointed General Chairman for the 1992 conference.

The project is working with several technology transition partners to build prototyping and modeling tools for real-time systems using Durra: Institute for Simulation and Training (University of Central Florida), MITRE Corporation, Hughes Aircraft Corporation, and GTE.

The project leader and a member of the Technology Applications group visited NASA Langley, Naval Research Laboratory, University of Maryland, and NASA Goddard to gather information for a survey of software engineering technology for distributed avionics applications.

Inertial Navigation System Simulator Program: Top-Level Design
(CMU/SEI-89-TR-38)

Hartstone Benchmark User's Guide, Version 1.0
(CMU/SEI-90-UG-1)

For information on how to order reports, see page 27.

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Software for Heterogeneous Machines

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Software Systems Program Reports

January-March 1990

Education

The primary objective of the SEI Education Program is to increase the number of highly qualified software engineers by rapidly improving software engineering education throughout the education communities of academia, government, and industry. To accomplish this, the projects of the Education Program focus on accelerating the development of software engineering programs in academia and on enhancing opportunities for the continuing education of practitioners.

The University of Arizona has become an academic affiliate. The academic affiliates are educational institutions who have contractually joined the SEI in cooperative efforts of mutual interest. These efforts include work in education, training, research, development, or technology transition.

Two new courses were offered by Carnegie Mellon as part of its new Master of Software Engineering (MSE) program, a joint effort between the SEI and the CMU School of Computer Science. The Software Development Seminar features a series of lectures by software professionals. This course encourages active participation of the students and lecturers. The Software Development Studio consists of a team effort by the students to complete all phases of a realistic software development project. Four students are enrolled in each of these courses.

The Software Engineering Curriculum Project is developing model curricula, promoting the creation of both graduate and undergraduate software engineering programs in the academic community, and increasing the amount of software engineering content in both graduate and undergraduate computer science programs. The project develops curriculum modules, classroom support materials, and other educational materials to promote the teaching of software engineering. It holds a semi-annual Educator Development Workshop (formerly called Faculty Development Workshop) and an annual Conference on Software Engineering Education as two of the mechanisms for disseminating its work to the education community.

The Seventh SEI Educator Development Workshop (EDW) was held in January 1990. The 85 attendees included representatives from more than 50 colleges and universities, and 7 corporations. Participants attended a half-day tutorial on software reliability measures as well as formal presentations and small-group discussion sessions. They also received educational materials and curriculum modules on topics such as software specification and requirements, design methods for real-time systems, teaching software engineering ethics, and teaching writing to software engineers. (See the document list on page 15 for new releases.)

A visiting scientist from the University of Ulster, Northern Ireland, has begun a six-month sabbatical at the SEI. He is currently working on the development of a curriculum module on concurrent programming, which will be available in April. ►

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**Software Engineering
Curriculum**



The 1990 SEI Report on Undergraduate Software Engineering Education (CMU/SEI-90-TR-3) was released in March. The report discusses fundamental issues of undergraduate software engineering education and provides information about topics such as course content and accreditation.

The project leader gave a talk titled "The Future of Software Engineering Education" as part of a colloquium series sponsored by the computer science department at the University of Iowa. The talk was telecast to Rockwell in Cedar Rapids.

The project leader also presented a tutorial on teaching a software engineering project course at the ACM SIGSCE Technical Symposium on Computer Science Education.

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Video Dissemination

The Video Dissemination Project provides courses on modern software engineering methods. The project has three series of videotaped courses: the Academic Series, which develops graduate courses that are offered by universities for academic credit; the Continuing Education Series, which offers noncredit courses to software practitioners in government and industry; and the Technology Series, which provides stand-alone presentations that promote awareness of emerging issues and leading-edge technologies.

The Academic Series began its sixth semester of production by videotaping two courses: Software Creation and Maintenance, and Software Verification and Validation (version 2). Presentation of these courses began at Carnegie Mellon University in January. The videotaped versions will be available to participating schools for the fall 1990 semester.

The videotaped version of Software Design is offered this term at McGill University, Eastern Michigan University, and University of Houston, Clear Lake. Software Verification and Validation is offered at Mississippi State University, East Tennessee State University, and the University of Minnesota, Duluth. Software Project Management is offered at Carnegie Mellon University, Florida Atlantic University (six sites), Florida Institute of Technology, Rose-Hulman Institute of Technology, The Wichita State University, Eastern Michigan University, and Temple University. Tutors for these courses attended a one-day orientation session at the SEI.

In the Continuing Education Series, the third offering of Software Project Management for Tutors course was completed this quarter. Eight individuals, representing the National Security Agency, Martin Marietta, and McDonnell Douglas completed the course and received 5.4 continuing education units. They are now qualified to serve as learning facilitators—or "tutors"—for the course at their respective organizations. The tutors received guidance in tailoring the course to meet the educational requirements of their organizations.

Six instructors from the Air Force Institute of Technology (AFIT) and one representative each from General Dynamics and the University of Scranton are spending six months at the SEI participating in a Course Development Workshop. The workshop participants are working with SEI staff members to define the content of and develop materials for AFIT software engineering courses. The five graduate-level continuing education courses resulting from this workshop will be presented at AFIT by its own instructors.

The Advanced Learning Technologies (ALT) Project is using hardware and software technologies to teach software code inspections. Interactive, technology-intensive training can be distributed economically to a broad audience and can provide an effective learning experience.

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**Advanced Learning
Technologies**

The ALT project leader demonstrated ALT work as part of a panel at the Fifth International CD-ROM Conference and Exposition sponsored by Microsoft in February. Also on the panel were representatives from Apple, Ashton-Tate, and Metamedia, a DoD CD-ROM/interactive video producer.

The first CD-ROM check disk was created. Project members are currently integrating and testing the data on this disk with existing code. A second check disk will be made, based on the results of these tests. Parse tables were integrated into the talk interface. These parse tables interpret what the student of the code inspections course says and allows the student to take an active role in an inspection simulation.

"Intelligent Interactive Video Simulation of a Code Inspection," by the project leader, has been translated into Japanese and published in the journal *Nikkei Artificial Intelligence*. The paper originally appeared in the July 1989 issue of *Communications of the ACM*.

The project leader was interviewed for an ACM article and appeared in an ACM Video Presentation titled "Interactive Digital Video." The SEI Software Engineering Video Network provided editing facilities and personnel. The video was distributed by ACM Press in conjunction with a special edition of the *Communications of the ACM*. The program featured interviews with prominent figures in digital video/multimedia development and research.

1990 SEI Report on Undergraduate Software Engineering Education
(CMU/SEI-90-TR-3)

Software Specifications: A Framework
(SEI-CM-11.2.0)

Software Requirements
(SEI-CM-19.1.1)

Software Design Methods for Real-Time Systems
(SEI-CM-22-1.0)

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**Education Program
Reports**
January-March 1990

For information on how to order modules and reports, see page 27.

Ada & STARS Support

Project members have been working on a number of projects to support the STARS program. The first project is the development of a software engineering approach to support the STARS program. This approach is based on the STARS program's requirements and is designed to support the STARS program's development and maintenance. The second project is the development of a software engineering approach to support the STARS program's testing and validation. This approach is based on the STARS program's requirements and is designed to support the STARS program's testing and validation. The third project is the development of a software engineering approach to support the STARS program's documentation. This approach is based on the STARS program's requirements and is designed to support the STARS program's documentation.

The Software Architectures Engineering (SAE) Project provides technical guidance to DOD program offices in applying innovative, model-based software engineering solutions to the problems that characterize an application domain. The project is working with the Granite Sentry Program Office on part of the replacement for the NORAD system in Cheyenne Mountain, and with the Army WWMCCS Information System (AWIS) Program Office. The project is also working with the Advanced Millimeter-Wave Seeker (AMMWS) Program Office to change the Maverick air-to-ground missile seeker from infrared sensing to millimeter-wave radar sensing, with Ada as the implementation language. In each effort, project members are taking an active role in the design and development of the system.

Project members finalized *A Model Solution for C&I Translation and Validation* (CMU/SEI-89-TR-12), a document on the Message Translation and Validation (MTV) model, which is available for public release. The document was sent to Granite Sentry representatives and more than 50 other interested contractors and government organizations. A sizing analysis was performed on the MTV code to reduce the MTV typecaster object-code size on the Granite Sentry Phase II workstations. The results were transmitted to Granite Sentry.

Project members also collected and examined Phase II metric information to gain insight into the advantages and disadvantages of the modeling approach to software development. Discussions with Granite Sentry revealed that the information that has been collected is too high level. Future discussions will decide which metrics are needed and can reasonably be collected.

Project members attended the Phase II test-readiness review to assess how Phase II is progressing. Project members also attended the Architecture Working Group meeting to provide input on modeling and to address issues and concerns regarding new message sets for future phases of Granite Sentry. Finally, project members began planning for potential participation on Granite Sentry in the future.

Project members supported the STARS AMMWS Shadow Project by reviewing the Hercules Project final report and helping Hercules prepare a presentation for the February AdaJUG. Work has begun on the final lessons-learned report. ►

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Software Architectures
Engineering



Project members began working with the Defense Advanced Research Projects Agency (DARPA) to help organize and possibly participate in a new program, Domain Specific Architectures (DSA). DARPA has approved the program, and funding issues are being addressed. The first task will be to organize an exploratory workshop to determine the goals and objectives of the DSA Program.

At the request of the Air Force Electronic Combat Office (AFECO) at Wright-Patterson AFB, project members organized and conducted a workshop for Electronic Combat Office system users and designers to assess the limitations of current environments and military hardware platforms. As a result of the workshop, AFECO requested that the SAE Project continue working with them on an 18-month experimental modeling effort, the Electronic Combat Digital Evaluation System. Project members are writing a direct support agreement for that effort.

The project continued work on developing model solutions to recurring problems for the AWIS Program. The MTV software developed for the Granite Sentry Program was modified to meet the requirements of the AWIS Program. A model solution for a generic report generator was also developed.

Project members analyzed design documents and Ada code from Release 1 of the mobilization and deployment segment, and from Release 2 of the transportation segment to identify potential models for reuse on AWIS.

Project members worked with two other SEI projects—the User Interface Project and the Binding of Ada and SQL Project—to begin development of model solutions for a man-machine interface and for an application-database interface.

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**Binding of Ada
and SQL**

The Binding of Ada and SQL Project, initiated at the request of the Ada Joint Program Office (AJPO), has investigated the problem of binding the Ada programming language with the Structured Query Language (SQL) database language. The solution to this problem was the specification of the SQL Ada Module Extensions (SAME), an interface that permits an application program written in Ada to access and manipulate data controlled by a database management system (DBMS) using SQL.

The SAME-Design Committee (SAME-DC), a group of experts from government, industry, and academia, met in February in Irvine, California, and completed the description of the language for describing SAME application interfaces. This language is now known as the *SQL Ada Module Description Language* (SAMeDL). An updated version of the SAMeDL reference manual is scheduled to be produced during the second quarter of 1990. The June meeting of the SAME-DC will be held in conjunction with the June meeting of the International Standards Organization Working Group on Ada (ISO/WG9). The current plan is to present the updated manual to the Ada/SQL subgroup of WG9.

Recently, the Army Tactical Command and Control System (ATCCS), a \$400-million, three-year project, has committed to using the SAME and the SAMeDL. The organization developing SIDPERS-3, the new Army personnel system, has used the manual implementation of the SAME (as described in CMU/SEI-89-TR-16). Representatives from both ATCCS and SIDPERS-3 have joined the SAME-DC.

The Ada Joint Program Office (AJPO) has decided that a revision to the Ada language standard is required to maintain it as a standard (ANSI/MIL-STD-1815A). This revision process is commonly referred to as Ada 9X. The purpose of this project, begun in February 1989, is to identify and evaluate potential areas for revising the Ada standard based on the experiences of software developers and compiler implementors. This project is providing an organizational framework to help guide revision activities.

Project staff advised the Ada 9X Project Office on proposals submitted for the mapping/revision effort. Reports on shared variables and fixed-point types were prepared and delivered to the project office. Work proceeded on the preparation of additional reports on reuse, input/output, optimization issues, mathematical processing, real-time, and distributed systems, and on review of draft revision requirements submitted by the requirements team.

The project was represented at the third Distinguished Reviewer meeting at the end of March. Distinguished Reviewers are a group of experts appointed by the Ada 9X Project Office, and part of the work under the Ada 9X direct support agreement is to attend their meetings.

A Model Solution for C3I Translation and Validation
(CMU/SEI-89-TR-12)

For information on how to order reports, see page 27.

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**Study and Analysis
for Ada 9X**

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**Ada & STARS Support
Reports**
January-March 1990

Technology Transition

The Technology Transition Program is the focal point for SEI transition efforts. The program works with other SEI programs to match problems and solutions in the DoD software community.

The Technology Applications Function provides a link between DoD mission-critical application domains and ongoing SEI activities in technology evaluation, development, and transition. The goal of these activities is to assist the efforts of organizations to adopt and institutionalize new technology through matching the technology to an appropriate context, fostering a climate of acceptance for the technology, and tailoring the technology for pilot installations. Transition sites are principally chosen for their ability to influence the further adoption of the technology throughout a larger community.

In this quarter, Technology Applications staff continued to assist simulator program offices that are addressing the problems of acquiring and developing simulator systems by using structural model technology. Within the flight simulator domain, the structural model concept continues to be used on several programs, including the Air Force C-17 transport program and the Navy SH-2G helicopter program. The use of structural models is now part of the NASA space station activity and is being considered for wide use by NASA.

The role of structural models expanded into the electronic combat simulation domain during this quarter. The SEI is planning to work with the Air Force Electronic Combat Office to develop an electronic combat simulator framework. This framework will use the structural model approach to identify key design problems and develop solution models for these problems.

As a long-term initiative to institutionalize the use of structural models, the SEI is working with the National Security Industrial Association (NSIA) Working Group for Simulators and USAF Aeronautical Systems Division/Training Systems (ASD/YW) on making acquisition practices consistent with the structural model approach.

A member of the Technology Applications staff hosted the second meeting of the Allied Standard Avionics Architecture Council (ASAAC) Software Task Group on February 28-March 2 at the SEI. The group, consisting of government delegations from West Germany, United Kingdom, France, and the United States, met to continue work on the ASAAC plan for the software roadmap program. This plan is a joint effort by the four governments to develop common avionics architectures and software development life cycles, methods, and environments among the industries in these countries.

Technology Applications supported the Air Force Air Defense Initiative Program Office in conducting a review of the final concept definition proposals submitted by five participating contractors. Technology Applications staff reviewed the content of the proposals, identified the software engineering issues, and noted the issues that were not addressed by the proposals. The concept definition study was aimed at setting the boundaries of the problem and establishing the confidence to proceed to the next step for the project, building a demonstration radar. Technology Applications staff also participated in the review of study results and contractors' final study briefings. ►

Technology Applications



The Distributed Ada Real-Time Kernel (DARK) Project concluded development and established baseline version 3.0 of the Kernel software and documentation, available for two targets: MC68020 and VAX/VMS. The Kernel software, documentation, and other DARK-related information are now available for anonymous ftp to the public, and are also available from the SEI in tape form; 30 copies of version 3.0 have been sent out to new and existing DARK users in government, industry, and academia. The DARK Transition Project will host a workshop on July 10-12 to discuss "Architecture for Real-Time Systems." The primary goal of this workshop is to bring together users of real-time, embedded systems to share solutions to common problems, to identify future directions, and to discuss what can be done to improve the state of the practice.



Affiliate Relations

The Affiliate Relations Function establishes and maintains SEI relationships with industry and government organizations. Affiliate Relations also negotiates and places, with the cooperation of the SEI Joint Program Office, government and industry resident affiliates at the SEI. The SEI Education Program manages academic affiliates and visiting scientists from academia.

Sixteen new industry affiliates signed information exchange agreements during this quarter: All Systems Inc.; American Institute for Research; Ball Systems, Engineering Division; Boeing Commercial Airplane Group; E-Systems, ECI Division; Eyring Inc.; Logicon Inc.; Mantech Services Corporation; The Matrix Group; Metalworking Technology Inc.; Objective Interface Systems Inc.; Plessey Electronic Systems Corporation; Schlumberger Laboratory for Computer Science; Software Process Innovations; Soncraft Inc.; and Systems Control Technology Inc.

Thirteen new resident affiliates from the following organizations joined the SEI this quarter: seven from the Air Force Institute of Technology and one each from Computer Sciences Corporation; Electronics Systems Division, United States Air Force; General Dynamics; Gunter Air Force Base; National Security Agency; and Wright-Patterson Air Force Base. Four resident affiliates concluded their work at the SEI during this quarter. As of March 31, 1990, twenty resident affiliates were working at the SEI: six from industry and fourteen from the services and government agencies.

Members of Affiliate Relations conducted SEI Visitors Day on February 15. This event is held quarterly to accommodate the increasing requests for visits to the SEI. Twenty representatives from nine companies and two government organizations attended. The next two Visitors Days are scheduled for May 17, 1990 and August 23, 1990. Visitors must contact Affiliate Relations to register for Visitors Day; walk-ins are not accepted.

In this quarter, Affiliate Relations began planning for the 1990 SEI Affiliates Symposium, to be held September 11-13, 1990, in Pittsburgh. The symposium will highlight both the state of software engineering technology and the state of software engineering practice.

The Empirical Methods Function supports transition management of SEI technology projects by providing market research methods and materials, conducting surveys, and evaluating events or validating products of SEI projects.

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Empirical Methods

Empirical Methods staff reported the results of the first phase of a two-phased study of U.S. software capacity to Air Force Systems Command (AFSC). The SEI is collaborating with ESD and MITRE in assessing the nation's capacity to produce software for the DoD. In the first phase of the study, 106 industry and Air Force executives were asked to rate the relative importance of factors that contribute to failure to meet schedules and budgets for software development contracts. The executives listed these factors as the ten most serious: inadequate requirements specification, changes in requirements, shortages of systems engineers, shortages of software managers, shortages of qualified project managers, shortages of software engineers, fixed-price contracts, inadequate communication for systems integration, insufficient experience as a team, and shortages of application domain experts. Empirical Methods staff also reported on readily available data about demand for Ada software, growth in demand for post-deployment software support (PDSS), and labor supply for software and systems development.

Empirical Methods staff conducted a telephone survey concerning the economics of Ada adoption. Those surveyed included senior technical and management staff of 50 companies working in 14 application areas. A report that summarizes the results of the survey will complete current SEI efforts to study and document MCCR industry decisions to adopt or not adopt Ada for use in specific application domains. The report is scheduled to be available by the summer of 1990.

CERT Coordination Center

The Computer Emergency Response Team Coordination Center (CERT/CC) supplements existing mechanisms by which informally organized experts deal with and prevent computer emergencies. The CERT/CC at the SEI supports two different communities: Internet users and developers of technology that is available on the network, such as Unix and networking software. The CERT/CC provides a dependable 24-hour point of contact for security issues and allows rapid communication during emergencies. It also raises constituents' awareness of security issues and assists individual organizations in improving the security of their systems. Finally, the CERT/CC maintains a highly secure repository of information for team members and cultivates close ties with researchers in the area of trusted systems to improve the security of existing systems.

Since its inception in 1988, the CERT/CC has responded to a continuous stream of reported security incidents. These include reports of intrusions, worms, and viruses as well as reports of vulnerabilities and suggested fixes for problems. In handling these problems, the CERT/CC issues advisories to the Internet community to warn them of problems and inform them of preventive techniques. In cases where vulnerabilities exist, the CERT/CC works with software vendors and the technical community in analyzing and resolving the problems.

During the first quarter of 1990, the CERT/CC worked with the Internet Engineering Task Force (IETF) to initiate a separate IETF security working area. A working group dealing with Internet security policy was initiated. This working group will produce recommendations for network security policy and will present those recommendations to the Internet Activities Board.

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CERT project members organized a second IETF working group focused on producing a security handbook for use by Internet-connected site and system administrators. The handbook will provide guidance on policy, administrative, and technical issues to support administrators' efforts to improve the security of their systems.

The CERT project members also established an online repository of computer security information. This repository includes listings of all CERT advisories and Federal Information Processing Standards Publications from the National Institute of Standards and Technology. More than 300 requests for information have already been processed.

The CERT/CC produced a draft charter and called a membership meeting of the CERT system, a federation of organizations working together to improve the security of their systems. Formalizing the relationship among the organizations will allow closer cooperation of group members and will also provide a mechanism for expanding group membership. ►



CERT project members completed planning for and recently announced the Second Invitational Workshop on Computer Security Incident Response, scheduled for June. This workshop will focus on new ideas and models in the area of incident handling as well as lessons learned. The workshop will focus on three broad sets of issues: managerial issues, threats and vulnerabilities, and communication issues. More than 40 speakers, each active in responding to and preventing computer security incidents, will present their work and will interact with session attendees.

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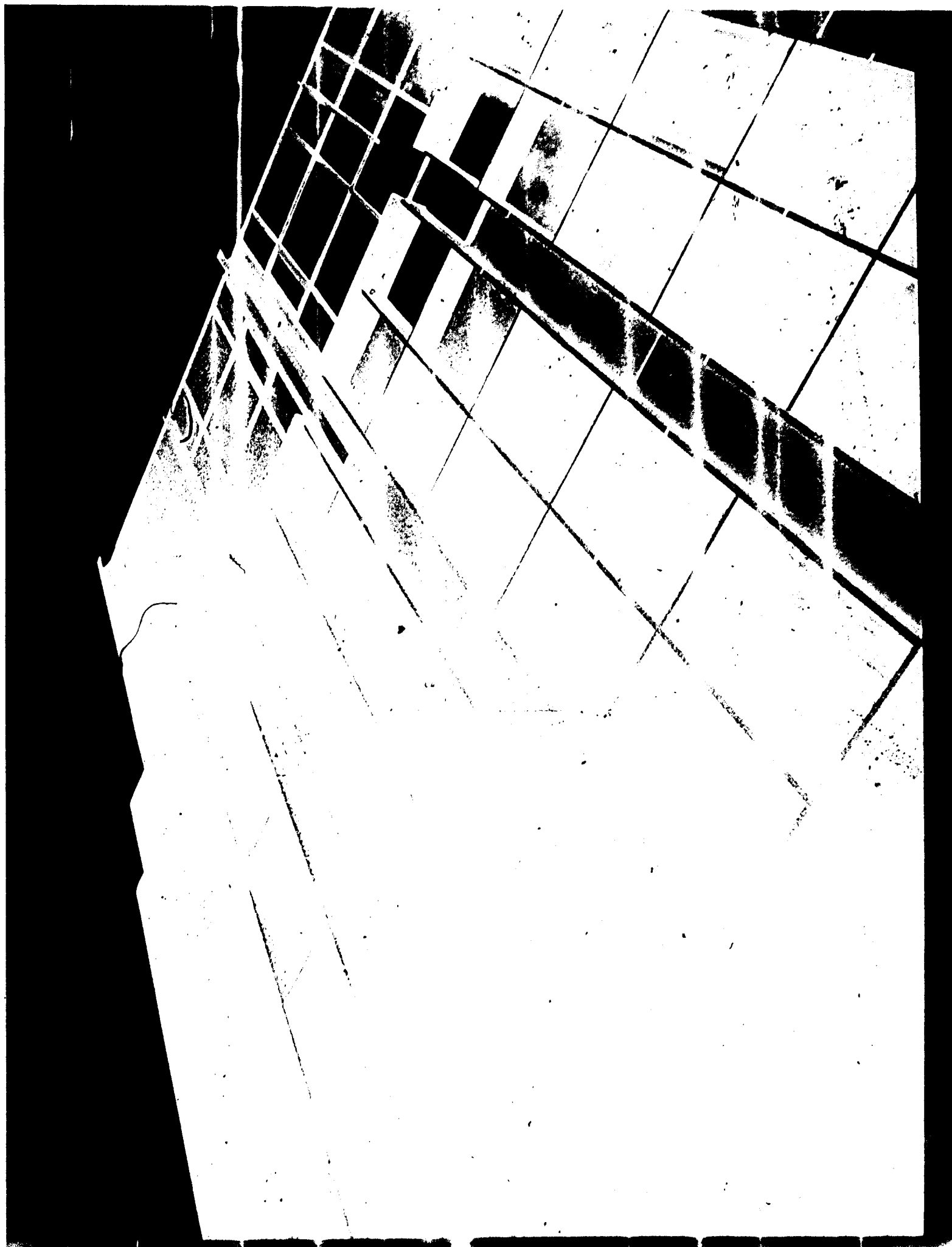
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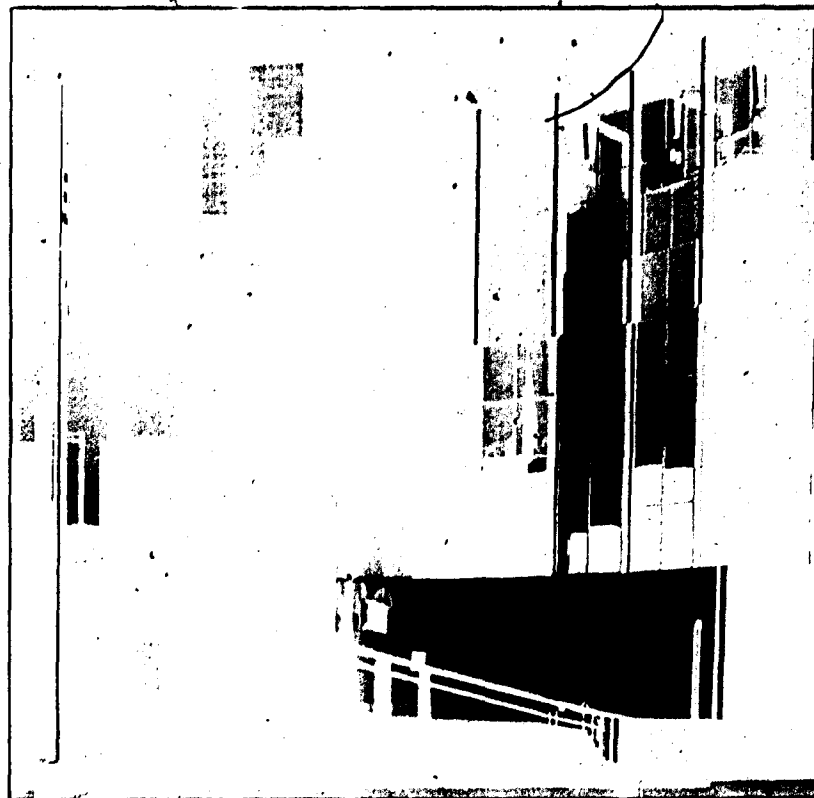
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